

The Implementation of Knowledge Management System (KMS) for the Support of Humanitarian Assistance/Disaster Relief (HA/DR) in Malaysia

Nuha Abdullah Hassan

Master of Information Technology, International Islamic University Malaysia
Malaysia

E-mail: nuha_rose_963@hotmail.com

Nur-Adib Hayiyusuh

Master of Information Technology, International Islamic University Malaysia
Malaysia

E-mail: reefhuns@yahoo.com

Rasha K. Nouri

Master of Information Technology, International Islamic University Malaysia
Malaysia

E-mail: rashaqaiss@yahoo.com

Abstract

Knowledge Management Systems are vital for disaster detection, response planning, and management. These systems aid in early warning, and provide decision support for disaster response and recovery management through the integration and collaboration form different organizations and agencies. This paper aims to propose the implementation of Knowledge Management System for the support of Humanitarian Assistance/Disaster Relief in Malaysia in terms of creating situation awareness and support decision makers to make the right decision in the timely manner. The proposed KMS will be adopted the KM framework and process from the previous studies.

1. Introduction

Malaysians are increasingly finding themselves exposed to disasters especially landslides and flood. During disasters, lives are lost; homes and workplaces are destroyed; essential services are disrupted, and hunger, injury, and diseases are widespread (Dongsong Z. et al, 2002). Thus, in order to assist in all stages of disaster relief the decision makers need a large variety of information, such as disaster situation, availability and movement of relief supplies, population displacement, disease surveillance, relief expertise, and meteorological satellite images or maps. In addition to that during HA/DR also require the intervention and aid of various agencies in a concerted and timely manner. As a result, HA/DR operations involve dynamic information exchange, planning, coordination and all negotiation. According to the mission stated by National Disaster Management Strategy of Malaysia: to advance national disaster management through effective coordination and integrated approach in the building of a culture of prevention, protection/public safety in the community.

In addition to that one of strategy to enhance Malaysia's capability in the future course and direction of disaster management stated that "To promote and develop regional cooperation and networking for exchanging, sharing and training on disaster management, as well as cooperation in rendering and receiving of disaster assistance, be it in the form of humanitarian assistance of the dispatch of search and rescue teams."

The above statement shows that collaboration and integration from various agencies is the key for humanitarian assistance and disaster relief and information technology is an enabler in order to collaborate and integrate information from different organizations and agencies. However, based on the need of collaboration and integration of information from different organizations and agencies, this paper is aimed to propose the Implementation of Knowledge Management to support Humanitarian Assistance/disaster Relief in Malaysia. This paper will be highlighting on the disasters occurred in Malaysia in the first part and followed by the discussion on Knowledge Management and Knowledge Management System. Model and framework from previous study will be discussed in the third part and this paper will be wrapping up with the conclusion.

1.1 Background of disaster in Malaysia

Disaster is defined as incident that occurs in a sudden manner, complex in nature, resulting in the loss of lives, damages to property or the environment as well as affecting the daily activities of local community (Dorasamy, M et al, 2010).

Such incident requires the handling of resources, equipment, frequency and extensive manpower from various agencies as well as effective coordination and the possibility of demanding complex actions over a long period of time. People are becoming ever more vulnerable to disaster incidents as climate change continues. The current climate of disasters in Malaysia suggests that an increasing occurrence landslide is caused by inadequate factors of safety at hill-site developments. For example, in the case of landslides at Ulu Klang area, unsafe walls and slopes manifested as landslides. Table 1 below shows details of several landslides at Ulu Klang and their causes.

Based on ADRC country report [6], wind storm, epidemic, wave surge, slides, floods, drought and wild fires are among the natural hazards likely to affect Malaysia. Some major disasters that hit Malaysia in recent years are shown in table 2:

Table1: Details of several landslides

Date	Landslide	Cause of landslide
December 1993	Block 1 of Highland Towers, Bukit Antarabangsa collapsed that caused 48 deaths	The most probable cause of collapse of the tower was due to the buckling and shearing of the rail piles foundation induced by the movement of the soil. The movement of the soil was the consequence of retrogressive landslides behind the building of Block 1. [1] Gue (2007) [2] summarized the above as: a) Design of the superstructure and materials was adequate. b) The failure of a rubble wall triggered a landslide which caused the building to collapse. The Factor of Safety (FOS) of the rubble was found to be less than 1.0, which is unsafe. c) The site is found to be tectonically stable and no active fault movements had been recorded.
May 1999	A few major landslides at Bukit Antarabangsa, fortunately no fatalities	Investigation results for the landslides at Bukit Antarabangsa by a team of engineers, geologists, hydrologists and surveyors reveals that: a) The landslides were due to high (about 66m) and steep (steeper than 35o) un-engineered filled slopes. b) These were aggravated by blockage of berm drains and cascading drains at the slopes.[2]
November 2002	The Taman Hillview landslide that caused 8 deaths.	The cause of landslide at Taman Hillview in 2002 was similar to the Highland Towers tragedy, where failure of a rubble wall again triggered a landslide. The Factor of Safety of the rubble wall in the Highland Towers was found to be less than 1.0 even without considering any presence of geological features such as relic joints etc and water table.[2]
May 2006	Landslide at Kampung Pasir - 4 deaths	Investigation of the Kampung Pasir landslide was still ongoing and no concluding cause reported. [2]

Source: Gue, S. S. & Liong C. H. (2007), "Is the Ground in Ulu Klang Unstable?", Jurutera, February 2007, page 32-33.

Based on the summary of people affected by the disasters many agencies are trying find the best way for disaster relief and reduction. Disaster relief refers to rescue people in the disasters. Rescue work should be at under the unified command of the rescue command center and cooperate with one another, such as fire, medical, transportation, and military units, ensuring rescue teams and supplies can arrive soon (Huang Ang, 2010). Information in disaster relief is an essential resource that translates into supplies, logistics, and cooperation among relief agencies. Speed, accuracy, and completeness of information can help save lives (Dongsong Z. et al, 2002).

Table2: Major disasters that hit Malaysia in recent years

Year	Disasters	Killed	Injured	Total Affected	Damage Cost (USDs)
2008	Flood			10210	
2008	Landslide	11	15	1422	
2007	Flood	33		158000	225m
2006	Flood	19		138000	343m
2005	Flood	17		100000	66m
2005	Mud Flood	3		2793	
2004	Flood	13	0	15000	
2005	Flash Flood	4	0	600	
2004	Tsunami	80	767	5063	14.6m
2005	Wild Fires	0	0	0	—
2004	Storm	0	0	1000	—
2004	Storm	1	0	40000	—

Source: ADRC Country Report 2008 and 2006, Retrieved from www.adrc.asia.com

The Federal Emergency Management Agency (<http://www.fema.gov>) defines three phases of the HA/DR process:

I. Pre-crisis phase

- Establish and maintain close working relationship with other HA/DR organizations
- Establish and maintain chains of coordination with regional/national networks
- Foster common understanding of relief coordination policy
- Organize and manage the collection and updating of basic data on hazards and disaster
- Monitor disaster related information sources for early warning purposes
- Fund raising from government/private sources

II. Crisis phase

- Mobilize resources
- Exchange information
- Coordinate assistance planning and operational resources via distribution network
- Disseminate requirements

III. Post-crisis phase

- Finalize reporting and evaluation
- Disseminate lessons learned
- Propose adjustment of existing tools and procedures
- Facilitate the institutional hand-over for transition activities

However, Information needs vary in different phases of disaster relief and also vary for different people.

1.2 Problems with current HA/DR support system

Currently, numerous numbers of knowledge management have been adopted and supported by information technologies and day after day the number of the involvement and cooperation in disaster response is increasing. Yet, Knowledge Management in HA/DR is still in its early stages due to the reason of the wide distribution of data and information which is owed by a large number of organizations.

Users find difficulties to accommodate and translate the vast variety of data into real-time, multi-dimensional information that could be integrated into common HA/DR situational awareness picture.

The reasons of those difficulties are as follows:-

- The structure of the information is characterized by a high degree of range and variety.
- Knowledge resources are organized inefficiently which causes rare efficiency in utilized knowledge resources during HA/DR operations.

- Some of relief agencies do not have their own data resources and have no idea of which information the other agencies have, to aid them on decision making or disaster response.
- The International Federation of Red Cross and Red Crescent Societies (IFRC, 1997) summarized that 'there has been little emphasis on identifying what information is necessary in relief, which stakeholders need it, how it should be used, or the way new technological tools can facilitate systematic data collection and communication.'

In addition to the above mentioned reasons, there are few limitations with the relief websites/ portals, which are as follows:-

- During the disaster response phase, the relief website/portal is not enough interactive.
- Although the archived information is categorized, most of the information is in the form of original text documents, which are infeasible to be analyzed and reused in a time-critical environment. (Dongsong Z. et al, 2002)

However, regardless of the advanced technology achievements, many decisions are still taken in emergencies with little information beyond that in people's heads, due to the reason of an enormous amount of information is collected but not efficiently used. The minority of relief organizations/agencies use situation reports for relief planning or post-disaster due to the reason that they are not efficiently structured for the reuse and analysis studies. It lacks human effort and time to locate and process those relevant documents. As an example, to provide important information for the plan phase when assignment of personnel and delivery of supplies must be carried out efficiently and quickly, the situation reports must offer timely information on the situation, describe the demands of the victims' needs, and indicate possible future trends.

Thus this project concentrates on Knowledge Management framework for the support of HA/DR.

2. Literature Review

2.1 Knowledge Management Concept

Knowledge Management (KM) is referred to the entire process of acquisition, management, and utilization of disaster information and knowledge for the support of Humanitarian Assistance/Disaster Relief HA/DR operations (Dongsong Z. et al, 2002). KM is responsible for determining which information is needed and for overseeing the acquisition and dissemination of information. Improving KM efficiency can not only assist decision-makers in doing their job faster, cheaper, and better, but also enable various groups to share and reuse different resources. It is the key to the success of real-time decision making. Jennex (2005) defines knowledge management as the practice of selectively applying knowledge from previous experiences of decision-making to current and future decision making activities with the express purpose of improving the organization's effectiveness. Additionally, Jennex et al (2007) stated that the KM success is reusing knowledge to improve organizational effectiveness by providing the appropriate knowledge to those that need it when it is needed. Today, more and more information technologies have been adopted in support of knowledge management however, KM in HA/DR is still in the early stage.

2.2 Knowledge Management System

A knowledge management system (KMS) is the system developed to aid knowledge users in identifying, sharing, retrieving, and using knowledge they need (Murphy, T. & Jennex, M.E, 2006). Otim (2006) also stated that Knowledge Management Systems are vital for disaster detection, response planning, and management. These systems aid in early warning, and provide decision support for disaster response and recovery management. Managing past knowledge for reuse can expedite the process of disaster response and recovery management. KMS, in essence, plays important role in gathering and disseminating the natural disaster related information (Dorasamy, M et al, 2010). In the case of India, Ministry of Home Affairs in collaboration with UNDP (United Nations Development Programme) National Disaster Risk Management Programme built a KMS portal as an initiative to connect all government departments, statutory agencies and research organizations/institutions to share collectively and individually their expert know-how's.

Murphy & Jennex (2006) in their study of the use of KMS in Hurricane Katrina response concluded that KMS should be included in all crisis response. Mistilis, N. & Sheldon, P. (2005) described that knowledge is a powerful resource to help governments, organizations and communities prevent, mitigate, plan for & recover from disasters & crises. Additionally, in recent years, disaster managers have realized the potential of KMS for faster and more organized response to natural disasters. The large number of groups that respond to a disaster all need access to a wide range of real-time information, requires coordination. Groups have proposed and created KMS that allow for more efficient use of data and faster response. One example that has been proposed is the Information Management System for Hurricane disasters (IMASH) (Iakovou & Douligieris, 2001).

IMASH is an information management system based on an object-oriented database design, able to provide data for response to hurricanes. IMASH was designed with the premise that the World Wide Web is the medium of choice for presenting textual and graphical information to a distributed community of users. This design is much more effective in the fast-changing environment of a natural disaster than the historical use of static tools which, out of necessity, have been the tools used in disaster response. KMS uses a variety of technologies designed to enhance knowledge storage and knowledge communication/transfer. One of the examples of a recent development in KMS technology is the use of the wiki (Raman, M. et al, 2006). A wiki is a website or similar online resource which allows users to add and edit content collectively and/or collaboratively. Another example of knowledge based system which has implemented is ReliefWeb, this system serves as an electronic central repository to meet the information needs of the humanitarian relief community. ReliefWeb enables users to access the information via the Internet at any time, any place.

It contains daily-updated disaster information in a large variety of types, including situation reports, maps, press releases, appeals, and so on. Information is organized into multiple categories and indexes are established. This enables users to slice and dice information. But ReliefWeb still insufficient enough in terms of, first it is not interactive enough during the crisis-response phase. Second, although the archived information is categorized, most of the information is in the form of original text documents, which are offer infeasible to be analyzed and reused in a time-critical environment. For example, situation reports per timely information on the situation, describe the demands of the victims' needs, and indicate possible future trends. They provide important information for the plan phase when assignment of personnel and delivery of supplies must be carried out efficiently and quickly. Few relief organizations or agencies, however, use situation reports for relief planning or post-disaster studies because they are not well structured for the reuse and analysis. It needs a lot of human effort and time to locate and process those relevant documents.

3. Proposed Solution and Discussion

In Malaysia, there is an urgent need of an organized common platform to capture, organize and share this knowledge and create a versatile platform (Dorasamy, M et al, 2010). However, in implementing KMS for the support of HA/DR in Malaysia we have adopted the KM framework proposed by D. Zang et al (2001). The core of the KM framework is a centralized knowledge base. Disaster information is used to obtain situation awareness about a particular disaster event, needs assessment, and statistical analysis, while knowledge and past experience are used to facilitate relief decision making. All of this information and knowledge is collected from various sources and kept either directly or indirectly in the knowledge base. For example, Disaster Management and Relief Committee (DMRC) need information on the previous disaster for the future reference and planning which will be extracted from knowledge base. Another example is Malaysian Meteorological Service (MMS) may want to update information and warning of occurrences and adverse weather phenomena into the knowledge base.

The knowledge base is composed of a collection of storage for diverse HA/DR information and knowledge. It primarily serves the framework for the following purposes:

- Providing recommendations of courses of action for HA/DR decision-makers;
- Maintaining both historical and newly updated information for pre-disaster prediction or systematic disaster analysis;
- Enabling information and knowledge sharing;
- Functioning as a federated resource for creating new knowledge.

Additionally, they define the following KM process that should be involved in supporting real-time HA/DR decision making and knowledge sharing: acquisition, filtering, indexing, linking, sharing, categorization, creation, and maintenance.

1. Acquisition

During the occurring of disaster there is no organization which have all information to lighten the damage, as the disaster information comes in the different forms such as field reports, on-line situation reports, remote sensing information, and satellite images, can be captured through various communication media.

The following steps for acquisition must be developed to ensure focused information acquisition for addressing relief needs of decision makers:

- Discover which critical information/knowledge is required by different disaster relief tasks.
- Identify which organizations or agencies are the major information sources for each particular relief task.
- Specify the standard structures for each kind of information and knowledge. For example, the original format of disaster situation reports is plain text. These reports are hardly used unless their contents are processed and restructured. For satellite images or maps, detailed metadata must be provided.

- Determine how to acquire the relevant information from those authorized sources. The organizations that own information sources could submit the newly updated information to the knowledge base as soon as it is available.
- Examine the acquisition process to make sure that it is manageable and can be aided by information systems and technologies. Dongsong Z. et al (2002) suggest that build an information portal to enable the decision-makers to know where to get the information when they need it. In case some important information is held for a profit, its metadata and location should be available in the knowledge base.

2. Filtering

After collecting information from various sources, there is a need to find out which information is relevant and which information is irrelevant or duplicated. Generally, the primary objective of information filtering is to sort through large volumes of dynamically collected information and present those that are likely to satisfy users' information needs.

3. Categorization, Indexing, and Linking

In the HA/DR knowledge base, indexing, categorization, and linking are performed to organize information and knowledge. Indexing is a critical method in achieving fast and accurate searching. It is the problem of assigning labels to cases or other information to ensure that the right information and knowledge can be retrieved at appropriate time. Indices should be abstract well enough to make items useful in a variety of future situations, and concrete enough to be easily recognizable. All of the disaster information and knowledge need to be categorized by some criteria, such as disaster type or location. Linking means to establish connections between relevant information and knowledge so that everything related to a specific disaster event in the knowledge base will be located through interconnected links.

4. Knowledge Creation

New knowledge can be derived through a number of different processes ranging from data visualization to data mining. The extracted information, such as various situation features, actions taken, the relief organizations involved, success of the resulting outcomes, and the information source, can be integrated and codified to generate well-structured disaster cases. Those cases are treated as knowledge for future reuse through case-based reasoning.

5. Maintenance

The system will keep receiving new HA/DR information and knowledge, and also periodically removes what are replicated and outdated. The following figure shows the overview of KMS for the support of HA/DR in Malaysia

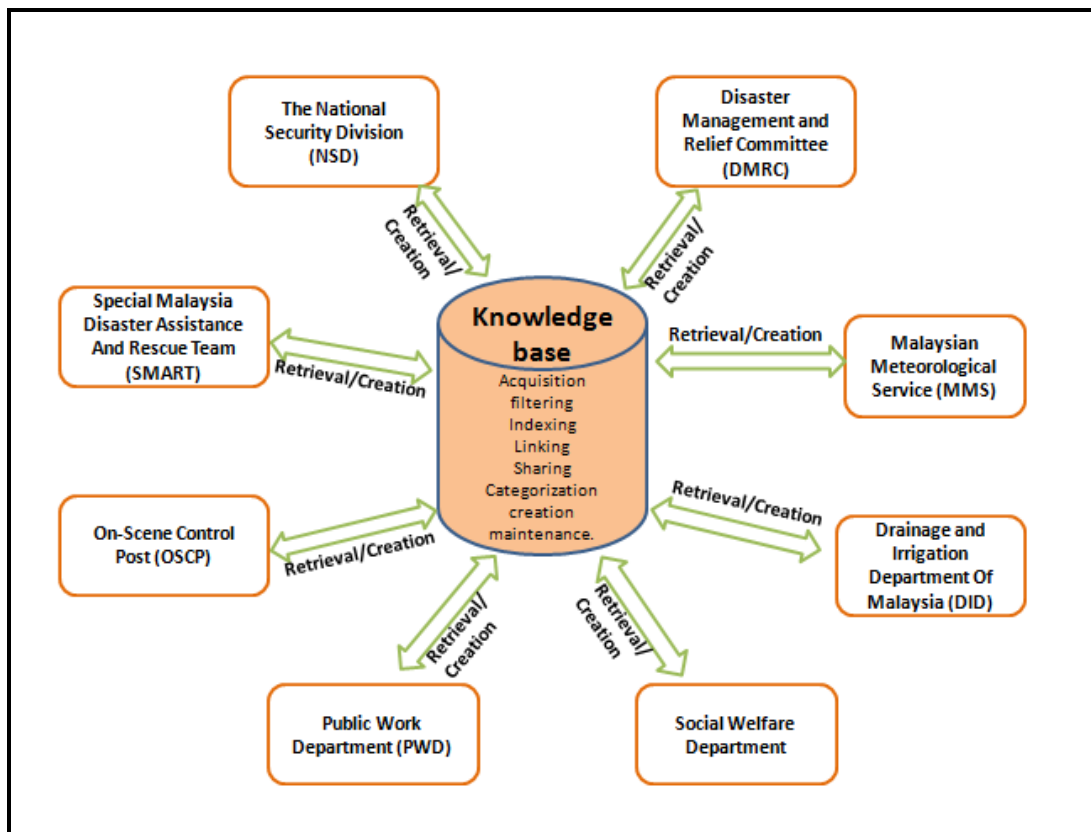


Figure1: KMS for the support of HA/DR in Malaysia.

In brief, the figure shows that the organizations which involved in the humanitarian assistance and disaster relief will be able to update the information that have and share with others and these organizations also able to acquire information that they need including information for pre-crisis, during the crisis and post crisis. All data will be stored in Knowledge base as shows in figure 1. Based on the National Security Council (NSC) Directive No. 20 states the mechanism on the management of disasters including the responsibilities and functions of the various agencies under an integrated emergency management system as follows

- **The National Security Division (NSD)** in the Prime Minister’s Department is responsible for coordination of all activities related to disaster.
- **Disaster Management And Relief Committee** carries out the responsibilities of the NSC in coordinating all the activities related to disaster management The main functions of the Disaster Management and Relief Committee (DMRC) are as follows
 1. Ensure sound coordination among the agencies involved in the handling of disasters and determines the roles of the principal emergency services (Police, Medical and Fire Department) and other supporting services;
 2. Activate the Disaster Operation Control Centre at District, State or Federal Level whenever required;
 3. Coordinate and mobilize resources and logistics available from Government agencies and if necessary also from the private sector;
 4. Coordinate assistance and rehabilitation to disaster victims;
 5. Carry out “post mortem” and report upon completion of the disaster operations for the purpose of recording and performance evaluation for future reference and planning.
- **Special Malaysia Disaster Assistance And Rescue Team (SMART)** SMART comprises of 85 officers and personnel from the Fire and Rescue Department, Royal Malaysia Police and The Armed Forces. The Team is equipped with specialized skills and equipment’s to respond to any search and rescue operation in any major disaster on land which is beyond the capabilities of the existing principal emergency services Search and Rescue (SAR) teams.
- **Malaysian Meteorological Service (MMS)** provides information and warning of occurrences and adverse weather phenomena to the public through the mass media or to other government agencies directly involved in disaster mitigation.
- **Drainage and Irrigation Department Of Malaysia (DID)** takes charge of: flood Control Measures, coordinate flood relief operations at federal, state and district levels.
- **Social Welfare Department** is the main organization in charge of disaster relief and rehabilitation works (NSC Directive No. 20 on Policy and Mechanism of Disaster Management and Relief).
- **Public Work Department (PWD)** responsible for construction and maintenance of public infrastructure in Malaysia such as federal and state roads, public government building, electricity, waters and much more.

In order to implement the successful Knowledge Management System for the use of HA/DR for Malaysia, there above organizations must be willing to collaborate and agree to share information among them. According to Kapucu (2008) on his study of the Collaborative Emergency Management stated that emergency response operations are also more effective when the organizations from different sectors interact with one another prior to a disaster.

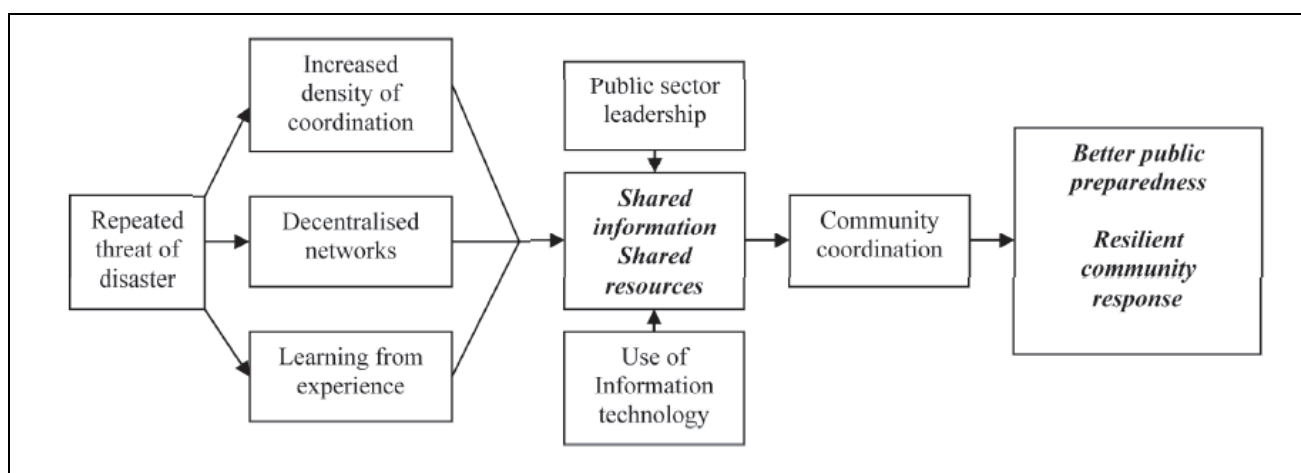


Figure 2 : Kapucu 2008

Pre-disaster communication is a key aspect of truly effective community preparedness and response. Successful participation in these pre-disaster, consensus-building emergency planning processes can lead to strengthened organizational relationships and thus improve post-disaster action. Tierney, Lindell and Perry (2001) suggest that there is a direct correlation between preparedness and level of experience: the more an individual, household, or organization has been exposed to disasters the more prepared, they tend to be. The below figure describes that when all parties or agencies are willing to share their information and resources will create the coordination among the various supporting agencies, the consequence is it will lead to a better public preparedness and resilient community response. The public will be able to save life and minimize damage because of planning and coordination among entities.

People, Process and Technology

Three key components drive all improvements in software development productivity: the PEOPLE involved, the organization of the development PROCESS, and the TECHNOLOGY used (Palazzi, P. & Khodabandeh, A. 1994). In order to implement the successful Knowledge Management System for the support of HA/DR in Malaysia we have to consider People, Process and Technology as a key to the success of the system development. Further elaboration on the key components listed below.

- **People:** refers to all organizations contributing and getting the benefits of database sharing. However, in order to facilitate the smooth processes, all organizations must agree and willing to share information/resources among them.
- **Process:** refers to the repeatable steps to accomplish business objectives. Starting from process of knowledge creation and knowledge retrieval.
- **Technology:** refers to the technology use to implement the Knowledge Management System for the support of HA/DR in Malaysia including IS and databases from MMS, DID, PW

The following figure shows the three key elements for the success of KMS for the support of HA/DR in

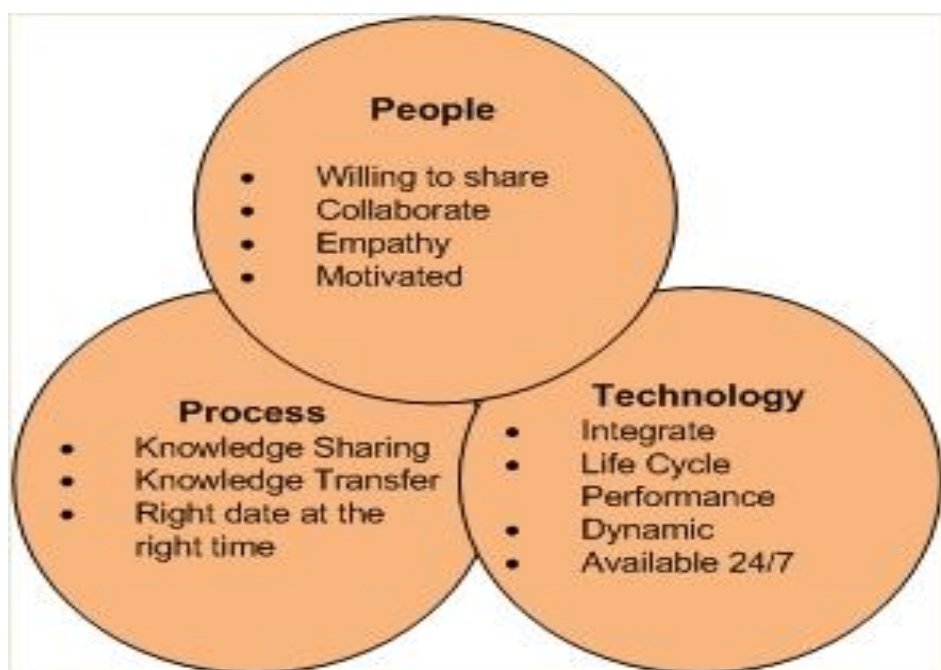


Figure 4: Three key elements for the success of KMS for the support of HA/DR in Malaysia.

The following diagram elaborates more on the three key elements involved in the implementation of Knowledge Management System for the support of HA/DR in Malaysia. One of the examples is that MMS is willing to share their resources to other agencies such as DMSC, OSCP, DID, PWD etc. The information which own by MMS will be beneficial to these organizations in order to perform their functions and responsibilities in the disaster management. They will be able to search information that they need and able to share information that they have via the process of searching and update their information and resources.

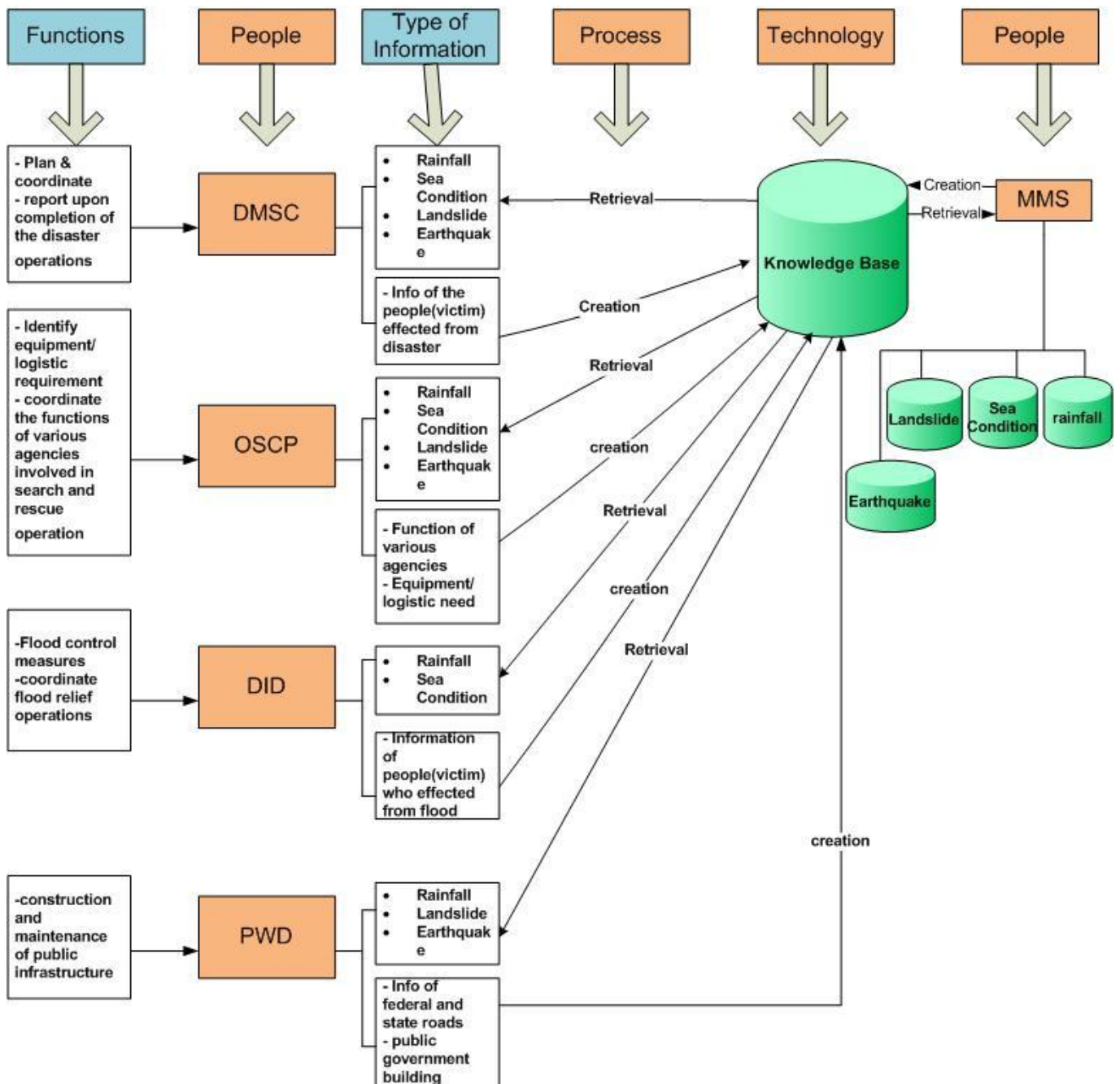


Figure 5: KMS for the support of Humanitarian Assistance/Disaster Relief in Malaysia

However, by implementing KMS for the support of HA/DR in Malaysia users will be able to understand what is going on, in another word it refers to situation awareness. For example, before responding to a disaster emergency, decision-makers must get a clear and good understanding of the current situation such as the severity of the disaster, the number of people dead or injured, the urgent demands in the damaged area, and so on. Thus, in this propose KMS will provide situation awareness which supported by the knowledge base as it contains newly updated information about disasters. Decision makers can retrieve all up-to-date items which relevant to a disaster. Once decision makers have understood on the current situation, they have to react immediately to reduce the damage. It is highly desirable that the knowledge about disaster relief and past experience kept in the knowledge base should assist the decision making of an ongoing disaster relief operation.

4. Conclusion

Disasters require extensive help from different relief organizations and agencies. This paper is proposed the implementation of KMS in the support of HA/DR in Malaysia to collaborate and integrate information resources from different organizations and agencies in order to create situation awareness and support decision maker to make the right decision within the timely manner. Additionally, managing knowledge across the various entities involved in such efforts is critical. This includes having the right set of information that is timely, relevant, and is governed by an effective communication process.

References

1. ADRC Country Report 2008 and 2006, Retrieved from www.adrc.asia.com.
2. Gue, S. S. & Liong C. H. (2007), Is the Ground in Ulu Klang Unstable?. *Jurutera*, 32-33.
3. Huang Ang, 2010," China's Emergency Management Mechanisms for Disaster Prevention and Mitigation", 2010 IEEE,DOI 10.1109/ICEE.2010.607
4. Iakovou, E. & Douligeris, C. (2001). *An information management system for the emergency management of hurricane disasters*. International Journal of Risk Assessment and Management, Vol 2, No 3/4, pp. 243-262.
5. Jennex, M.E.(2005), "What is Knowledge Management?" International Journal of Knowledge Management, Vol 1, No 4, pp. i-iv,.
6. Jennex, M.E., Smolnik, S., and Croasdell, D., "Towards Defining Knowledge Management Success", Proceedings of the 40th Annual.
7. Kapucu, N. (2008). Collaborative emergency management: better community organizing, better public preparedness and response, doi:10.1111/j.0361-3666.2008.01037.x
8. Mohanty, S., at al. (2005). *Knowledge Management in Disaster risk reduction. The Indian approach*. Ministry of Home Affairs, National Disaster Management Division, Government of India, Retrieved from <http://www.ndmindia.nic.in>
9. Murphy, T. and Jennex, M.E. (2006). Knowledge Management, Emergency Response, and Hurricane Katrina, *International Journal of Intelligent Control Systems*, 11(4), pp. 199-208.
10. Mistilis, N. & Sheldon, P. (2005). Knowledge Management For Tourism Crises And Disasters, *Tourism Review International Issues*, 10, 1/2 , 39-46.
11. Palazzi, P. & Khodabandeh, A. (1994). *Software Development: People, Process, Technology*. Published in the proceedings of the 1994 CERN School of Computing, Sopron, Hungary
12. Raman, M., Ryan, T., & Olfman, L. (2006). Knowledge Management System for Emergency Preparedness: An Action Research Stud. Proceedings of the 39th Hawaii International Conference on System Sciences.
13. Tierney, K.J., M.K. Lindell and R.W. Perry (2001) *Facing the Unexpected: Disaster Preparedness and Response in the United States*. Joseph Henry Press, Washington, DC.
14. The Federal Emergency Management Agency Retrieved from <http://www.fema.gov>
15. The Malaysian Experience and Future Direction on Disaster Management Retrieved from <http://www.adrc.asia/countryreport/MYS/2003/page2.html>
16. Zhang, D. & Zhou, L. & Jay F. N. (2002). A Knowledge Management Framework for the Support of Decision Making in Humanitarian Assistance/Disaster Relief, *Knowledge and Information Systems* (2002) 4: 370-385